TF 2430

TF 2430

80 MHz Digital Frequency Meter

INSTRUCTION MANUAL

MP MASTER
MA23659

mi

MARCONI INSTRUMENTS

Supplement No. H 54811-002V

SAFETY PRECAUTIONS

- For inclusion in instruction manuals for mains operated equipment -

This equipment is protected in accordance with IEC Safety Class 1. It has been designed and tested according to IEC Publication 348, 'Safety Requirements for Electronic Measuring Apparatus', and has been supplied in a safe condition. The following precautions must be observed by the user to ensure safe operation and to retain the equipment in a safe condition.

Defects and abnormal stresses

Whenever it is likely that protection has been impaired, for example as a result of damage caused by severe conditions of transport or storage, the equipment shall be made inoperative and be secured against any unintended operation.

Removal of covers

Removal of the covers is likely to expose live parts although reasonable precautions have been taken in the design of the equipment to shield such parts. The equipment shall be disconnected from the supply before carrying out any adjustment, replacement or maintenance and repair during which the equipment shall be opened. If any adjustment, maintenance or repair under voltage is inevitable it shall only be carried out by a skilled person who is aware of the hazard involved.

Note that capacitors inside the equipment may still be charged when the equipment has been disconnected from the supply. Before carrying out any work inside the equipment, capacitors connected to high voltage points should be discharged; to discharge mains filter capacitors, if fitted, set the equipment supply switch to ON.

Mains plug

The mains plug shall only be inserted in a socket outlet provided with a protective earth contact. The protective action shall not be negated by the use of an extension lead without protective conductor. Any interruption of the protective conductor inside or outside the equipment is likely to make the equipment dangerous.

Fuses

Note that the supply fuse is connected in series with the brown (live) wire of the supply lead. If the equipment is connected to the supply via a two-pin plug, it will be possible for the fuse to become connected to the neutral side depending upon the orientation of the plug in its socket. In these circumstances certain parts of the instrument could remain at supply potential even after the fuse has ruptured.

To provide protection against breakdown of the supply lead, its connectors, and filter where fitted, an external supply fuse (e.g. fitted in the connecting plug) should be used in the live lead. The fuse should have a continuous rating not exceeding 6 A.

Make sure that only fuses with the required rated current and of the specified type are used for replacement. The use of mended fuses and the short-circuiting of fuse holders shall be avoided.

Instruction Manual
No. H 52430-900Y
for

80 MHz Digital Frequency Meter

TF 2430

Code No. 52430-900Y

mi
Technical Publications

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MARCONI INSTRUMENTS LIMITED
ST. ALBANS HERTFORDSHIRE ENGLAND

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Chapter 1

General information

1.1 INTRODUCTION

TF 2430 is a general purpose instrument suitable for measuring the frequency of signals in the band 10 Hz to 80 MHz. Its versatile input buffer and amplifier incorporating a.g.c. has a high tolerance of signal distortion and noise and ensures reliable operation over a wide dynamic range of input levels without the need for a manual control.

The counter has a bright 7-digit 7-segment l.e.d. display with memory, automatic position of decimal point, leading zero suppression and active indication of overflow, hold and external standard operation. Push button switches select the resolution required, the maximum being 0.1 Hz over the entire frequency range.

Fig. 1.1 80 MHz Digital Frequency Meter TF 2430

1.2 DATA SUMMARY

FREQUENCY RANGE :	10 Hz to 80 MHz.
SENSITIVITY :	25 mV r.m.s. sine wave. Built-in a.g.c. provides capability for handling signals over a dynamic range of up to 80 dB automatically.
MAXIMUM INPUT :	260 V r.m.s. at 50 Hz (sine wave), 5 V r.m.s. at 80 MHz (sine wave). Maximum d.c. : 250 V. Maximum a.c. + d.c. : 250 V r.m.s. at nominal 50 Hz, decreasing from 50 Hz to 80 MHz by approx. 3 x 10-6 V/Hz.

INPUT IMPEDANCE :	Approx. 1 MΩ in parallel with less than 25 pF. AC coupled via 0.1 μF.
DISPLAY :	7 digits with memory. (7 segment l.e.d. of 7 mm minimum height).
Units and resolution :	Three push buttons select gate times providing resolutions of 10, 1 or 0.1 Hz and indicate readout units. Decimal point automatically selected. Hold indication. Overflow indication. Leading zeros suppressed.
Display time :	Readout retained during gating period or held indefinitely by means of HOLD button.
ACCURACY :	±1 count ± stability of frequency standard.
FREQUENCY STANDARD :	Rear panel switch selects internal standard or external input. Front panel indication when external standard selected.
INTERNAL CRYSTAL OSCILLATOR	
Frequency :	10 MHz.
Adjustment range :	Compensation for ageing drift may be made by a front panel preset.
Temperature stability :	Within ±5 parts in 10^6 over the operating temperature range of the instrument.
Ageing rate :	Approx. ±2 parts in 10^9 per day at a constant temperature.
Auxiliary output level :	Internal standard available at rear panel at approx. 4 V pk-pk e.m.f. from approx. 2 kΩ source impedance, or greater than 100 mV pk-pk into 50 Ω.
EXTERNAL INPUT	
Frequency :	10 MHz (sine or square wave).
Input level :	2.5 V to 5.5 V pk-pk.
Input impedance :	Approx. 300 Ω, a.c. coupled.
OPERATING TEMPERATURE RANGE :	0 to 40°C.
POWER REQUIREMENTS	
AC mains :	95 to 130 V (115 V nominal). 190 to 264 V (230 V nominal).
Frequency :	45 to 500 Hz.
Consumption :	10 VA approx.

DIMENSIONS AND WEIGHT :	Height	Width	Depth	Weight
	100 mm (4 in)	220 mm (8 3/4 in)	310 mm (12 in)	2.2 kg (4 3/4 lb)

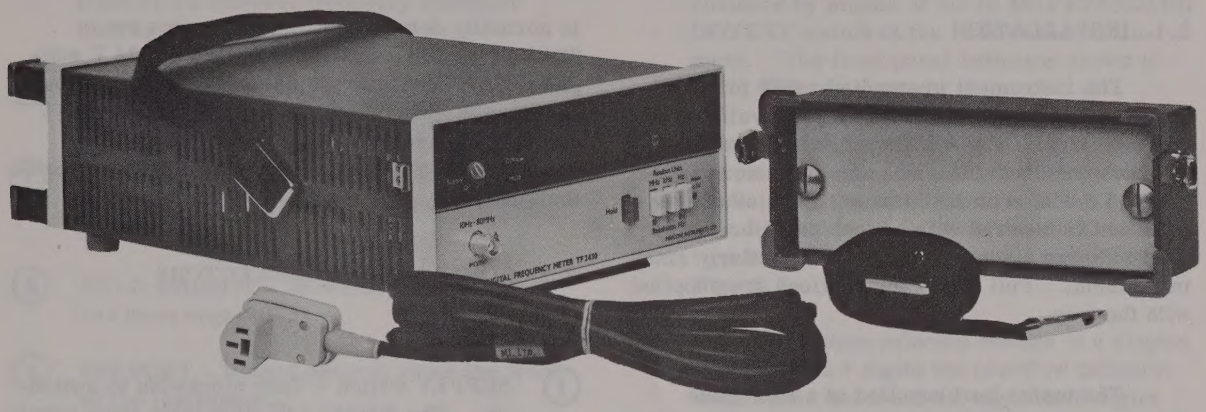


Fig. 1.2 Instrument complete with accessory kit

1.3 ACCESSORIES

		MI Code
Supplied	Mains lead (detachable).	43123-076Y
Optional	Accessory kit comprising :-	46883-281N
	Stowage lid Rear stand Hand strap Shoulder strap Right angle entry mains lead	
	Rack mounting tray	46883-282L
	Coaxial lead, 1 m long, with 50 Ω BNC plug at each end	43126-013W

Chapter 2

Operation

2.1 INSTALLATION

The instrument is supplied ready for bench mounting but a rack mounting tray is available as an accessory. This consists of a housing with two compartments either of which will accommodate a TF 2430 without its case. The other compartment is covered with a blank panel or can be used to house a second TF 2430 or similarly sized instrument. Full fitting instructions are supplied with the tray.

The mains lead supplied is a free cable fitted at one end with a socket that connects with the 3-pin plug at the rear of the instrument. When fitting a mains plug to the lead make sure the following colour coding is observed :-

Live	-	Brown
Neutral	-	Blue
Earth	-	Green/Yellow

Before connecting the instrument to the power supply, check that the AC SUPPLY switch at the rear is correctly set and that the corresponding value of fuse is fitted. The instrument is normally despatched with the switch set to 230 V, i.e. for operation from 190 to 264 V supplies. To change to the 95 to 130 V supply range remove the switch locking plate, switch to 110 V and refit the plate to suit. Note that the fuse must also be changed to the rating indicated beside the switch.

2.2 CONTROLS AND CONNECTORS

Front panel

(1) SUPPLY switch - Turn clockwise to switch on. The display will illuminate when supply is on.

(2) INPUT socket - 50 Ω BNC connector.

⚠ CAUTION : Do not exceed the maximum a.c. or d.c. input levels stated in Sect. 1.2 - Data summary.

(3) HOLD - Push button action prevents the memory being updated. This allows the display to be retained indefinitely even if the input is removed. Push again to release and allow updating of the memory to continue.

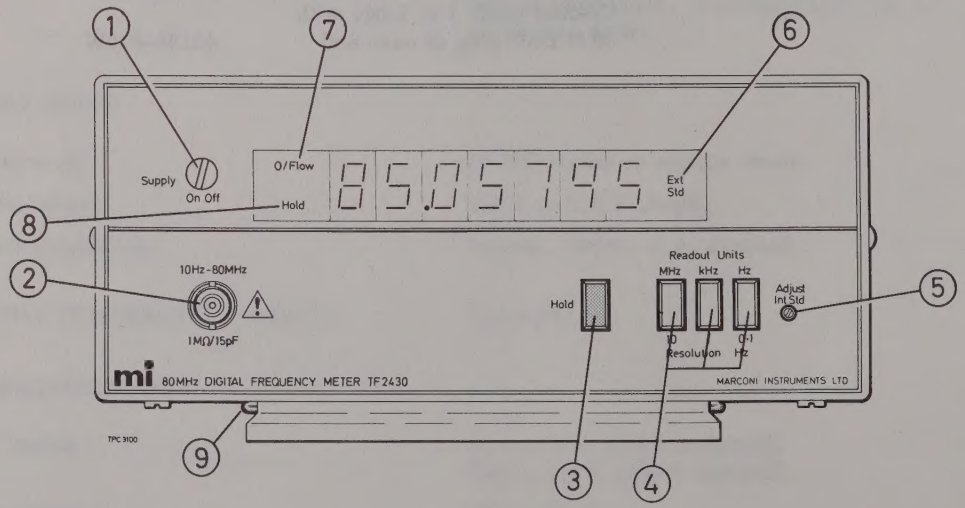


Fig. 2.1 Front panel controls and connectors

④ READOUT UNITS - Three interlocking push buttons select gate time hence resolution and decimal point position.

⑤ ADJ.INT.STD. - A screwdriver adjustable trimmer with 10 turns allows fine adjustment of the internal frequency standard (see Sect. 4.5).

⑥ EXT.STD. indicator - Shows that rear panel 10 MHz STANDARD - EXT has been selected.

⑦ O/FLOW indicator - Shows that the most significant digit or digits have overflowed the display.

⑧ HOLD indicator - Shows that HOLD button has been engaged.

⑨ SUPPORT - Hinges down to raise the front of the instrument.

Rear panel

10 MHz STANDARD - INT selects internal frequency standard whose output is then available at the OUT socket (50 Ω BNC).

EXT selects external frequency standard which must then be applied to the IN socket (50 Ω BNC).

⚠ CAUTION : Do not exceed 5.5 V pk-pk at the EXT IN socket.

AC SUPPLY - Position of locking plate allows switch to select either 230 V or 110 V supply and reveals appropriate fuse rating.

2.3 FREQUENCY MEASUREMENT

(1) Connect the signal to be measured to the input socket.

(2) Select the internal or external frequency standard by means of the 10 MHz STANDARD INT/EXT switch at the rear of the instrument. The front panel indicator shows if EXT. STD is selected.

(3) Select the required READOUT UNITS, noting the corresponding resolution figure, i.e. the value of the smallest units in the display. The decimal point position, readout calibration and gate and display times are shown in Fig. 2.2.

(4) If the resolution selected results in a display of more than 7 digits the overflow indicator illuminates and the most significant digits are 'lost'.

The display will be updated at the intervals shown in Fig. 2.2 unless the HOLD button is pressed. In this case the HOLD indicator will light and the display will be held indefinitely, even if the input signal is removed.

2.4 USE OF EXTERNAL STANDARD

As an alternative to using the internal crystal standard to provide the gating an external standard of 10 MHz may be used. Connect the external standard to the 10 MHz STANDARD IN socket and set the 10 MHz STANDARD switch to EXT at the rear of the instrument. Note that the EXT. STD. indicator lights on the front panel.

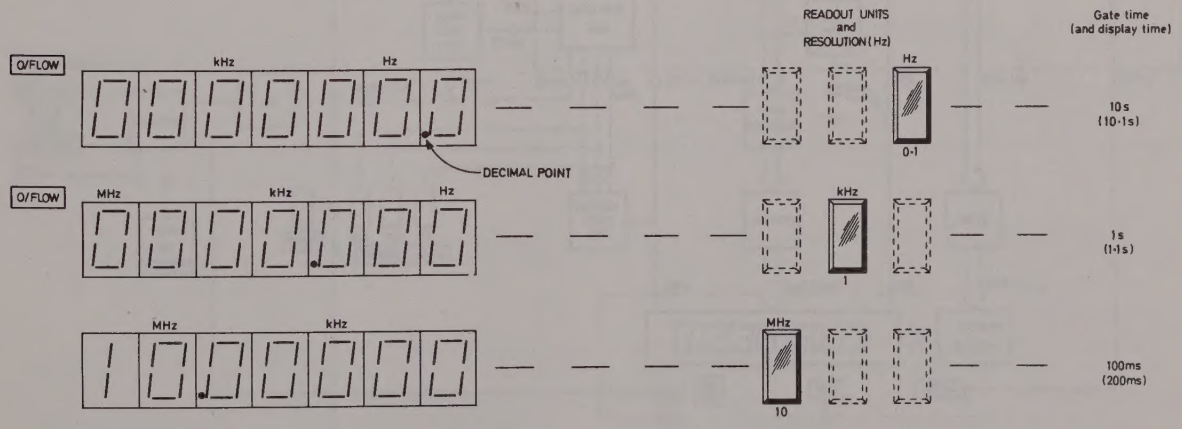


Fig. 2.2 Readout calibration and display data for a 10 MHz signal.

2.5 SELF CHECK PROCEDURE

A simple test to show that the instrument is working correctly can be performed by using it to measure its own standard output. This does not, of course, verify the accuracy of indication since any error in the standard will be cancelled by a corresponding error in the gating time which is derived from the same source.

To do the test proceed as follows :

(1) Connect the 10 MHz STANDARD OUT socket to the INPUT socket and terminate the signal into 50 Ω by using a T-connector.

(2) Set the 10 MHz STANDARD switch to INT.

(3) Select each of the READOUT UNITS in turn and check that the readout is within ±1 count of that shown in Fig. 2.2.

(4) Press the HOLD button and check that the HOLD indicator lights and that the readout is retained when the input lead is disconnected.

Chapter 3

Technical description

3.1 INPUT AMPLIFIER, GATE AND HIGH SPEED DECADES

The input signal is fed into an input buffer comprising a dual gate m.o.s. f.e.t. and emitter follower whose gain and, for high level signals, attenuation can be controlled by a d.c. voltage applied to the m.o.s. f.e.t. The output of the subsequent wide band amplifier is detected and converted into a proportional d.c. voltage which controls the buffer.

The output signal from this wide band amplifier is of constant amplitude and its level just exceeds the hysteresis window of the Schmitt trigger, thus ensuring reliable triggering even when the signal has a poor signal-to-noise ratio. The square wave from the Schmitt trigger is applied to one input of an i.c. gate and is gated by a signal whose duration is precisely controlled. The pulse train from the main gate is counted by an eight decade counter, two and a half decades of which are discrete i.c.'s and the remainder part of a custom designed l.s.i. m.o.s. i.c.

3.2 CLOCK SELECTION AND GATE GENERATOR

The counter's main reference clock can be generated from an internal crystal oscillator or introduced from an external 10 MHz source via the EXT STD IN socket.

Before being used to generate the gating signal or to retime the main gate the 10 MHz signal is divided by 10. This 1 MHz clock is fed into the m.o.s. i.c. and divided down by the selected ratio, the maximum being 10^7.

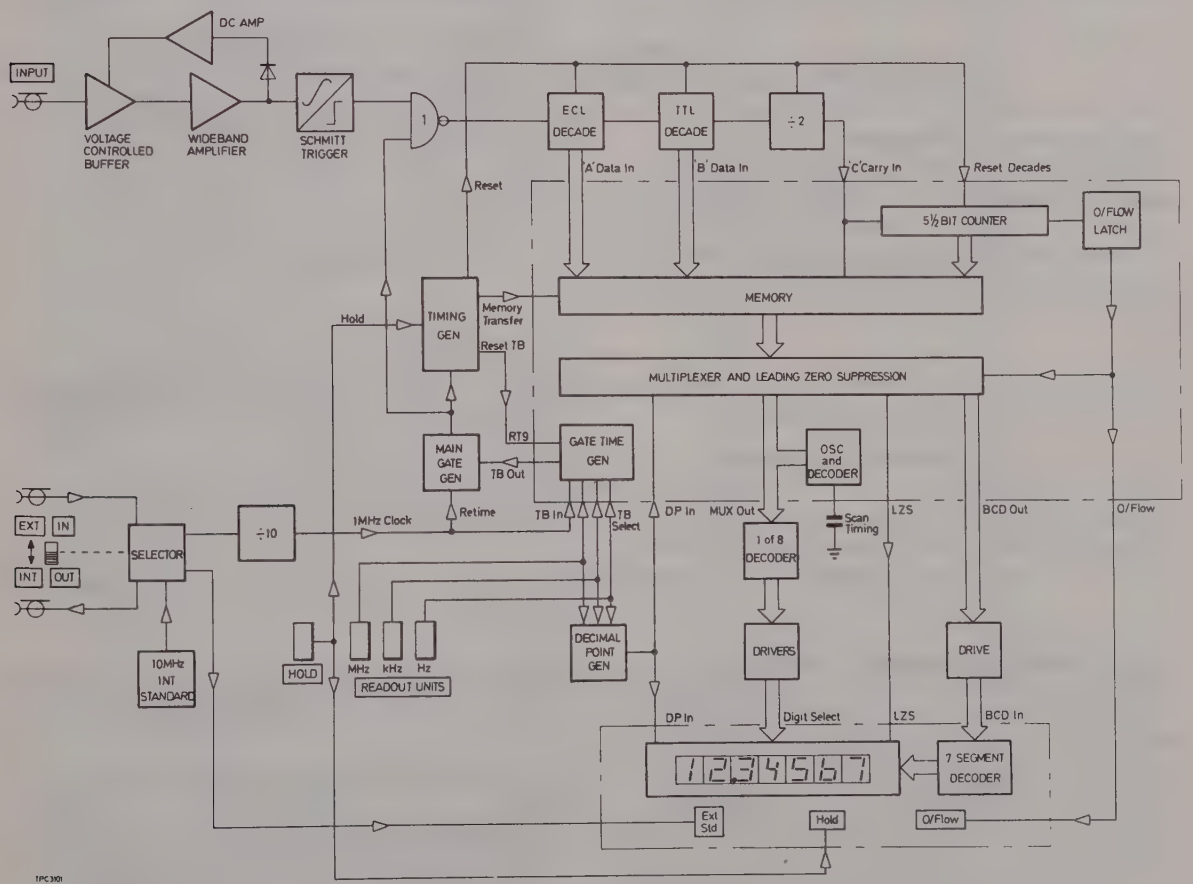


Fig. 3.1 Block diagram

The time base output is divided by two and retimed with the original 1 MHz clock signal before being applied to the main gate.

3.3 TIMING GENERATOR

TTL monostable integrated circuits generate a timing sequence which describes the display time, memory transfer and reset times. Waveform diagrams which show the timing sequences are illustrated in Fig. 3.2.

3.4 LOGIC CIRCUIT

A custom designed l.s.i. m.o.s. integrated circuit is the heart of the counter and contains all the digital logic that does not need to run at high currents or speeds.

The i.c. contains a $5\frac{1}{2}$ decade counter with overflow latch and an eight decade memory. Two and a half decades of the memory have a parallel data loading capability to enable the i.c. to be used with higher speed logic. The data from the memories are fed into a multiplexer which is controlled by an on-chip oscillator and 1 of 8 encoder. A signal for providing leading zero suppression is generated in the i.c. The 40 pin package also contains a time base section comprising a seven decade divider and a 1 of 7 data selector.

3.5 SWITCHING

Front panel controls select HOLD and one of three gate times. The 100 ms, 1 s or 10 s gates describe the display resolution, units and decimal point position.

3.6 DISPLAY BOARD

The display board contains the 7 segment l.e.d. displays and b.c.d. to 7 segment encoder with its associated current limiting resistors. The board requires 1 of n digit drive (where n = number of displays), multiplexed b.c.d. information, a decimal point signal and leading zero suppression signal. Three lamps are mounted on this board indicating HOLD, OVERFLOW and EXTERNAL STANDARD operation.

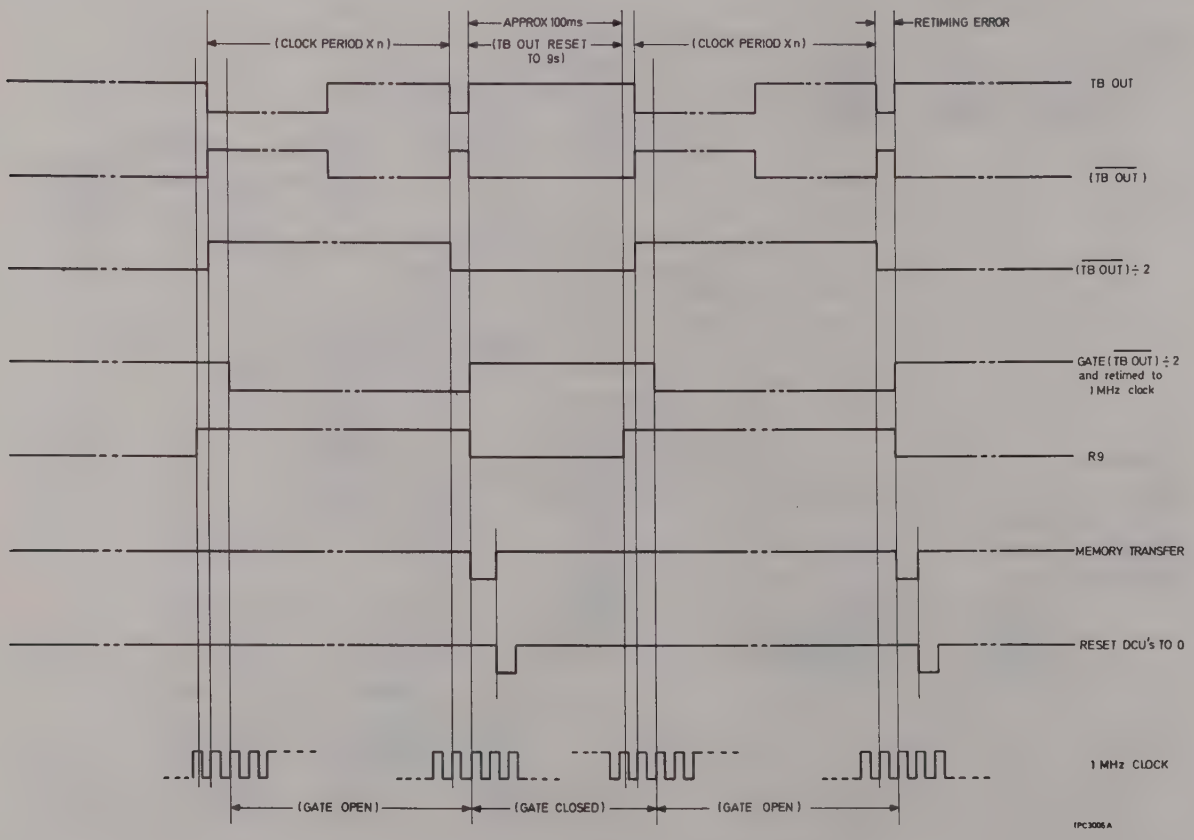


Fig 3.2 Timing sequence

Chapter 4

Maintenance

4.1 GENERAL

This section is intended as a general guide to the servicing of the instrument. In case of difficulties that cannot be resolved with the aid of this book, or for advice on maintaining the instrument, please write or phone our Service Division or nearest Area Office or Agent. Always mention the type number or serial number of your instrument. (Address on rear cover).

The only part of the instrument which should need regular attention is the 10 MHz oscillator. This should be periodically checked to ensure that it is operating at the correct frequency, and adjusted to offset any ageing drift that has taken place.

CAUTION Static sensitive components

Components identified with the symbol ⚠ on the circuit diagrams and/or parts list are static sensitive devices. The presence of such devices is also indicated in the equipment by orange discs, flags or labels bearing the same symbol. Certain handling precautions must be observed to prevent these components being permanently damaged by static charges or fast surges.

(1) If a printed board containing static sensitive components (as indicated by a warning disc or flag) is removed, it must be temporarily stored in a conductive plastic bag.

(2) If a static sensitive component is to be removed or replaced the following anti-static equipment must be used.

A work bench with an earthed conductive surface.

Metallic tools earthed either permanently or by repeated discharges.

A low-voltage earthed soldering iron.

An earthed wrist strap and a conductive earthed seat cover for the operator, whose outer clothing must not be of man-made fibre.

(3) As a general precaution, avoid touching the leads of a static sensitive component. When handling a new one, leave it in its conducting mount until it is required for use.

4.2 FUSES

The counter is protected by a delay fuse (FS1) in the line conductor of the mains supply. The instrument should be turned off while the fuse is changed. Access is by means of a screw cap on the rear panel.

4.3 REMOVING COVERS

The cover is retained by two screws at the back of the instrument. These screws also hold the protective clamps and their removal allows the case to be slid backwards over the rear panel. The separation of instrument and case is best achieved with the instrument upside down.

4.4 ACCESS TO POWER SUPPLY

The function board and transformer support chassis are held between the two side frames of the uncased instrument.

Power supply components are below the chassis and access to them can be gained by hinging the chassis forward into a vertical position. This is done by removing the two chassis retaining screws on the rear panel and the rear two screws holding the chassis to the side frames. The remaining side frame screws should then be slackened, so that the chassis may hinge about them, and tightened to hold it in a convenient position. No electrical connections need to be removed.

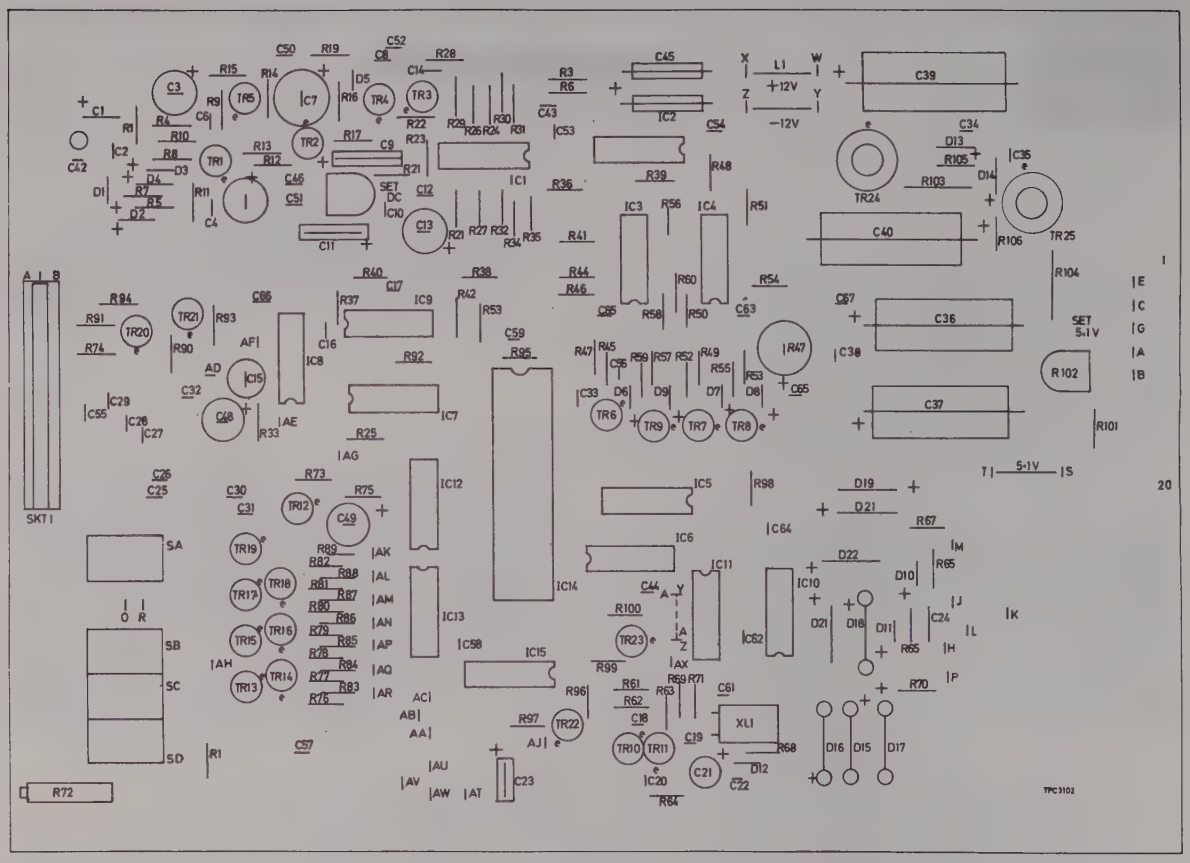


Fig. 4.1 Component layout

4.5 ADJUSTMENT OF INTERNAL 10 MHz STANDARD

The accuracy of the internal standard can be checked by comparing it with an accurately known external standard as follows :

(1) Set the 10 MHz STANDARD switch to INT.

(2) Connect a known external frequency to the INPUT socket. The value of the frequency is unimportant, although higher frequency allows greater discrimination.

(3) If necessary fine adjustment of the internal standard can be done, without removing the instrument from its case, by means of the ADJ. INT. STD. facility on the front panel.

If the internal standard cannot be set accurately with the ADJ. INT. STD., coarse adjustment to the oscillator frequency can be carried out by means of a preset variable capacitor (C21). Access to this is obtained by removal of the instrument case.

4.6 ACCESS TO DISPLAY BOARD

The display board is mounted in a 20-way edge connector at the front of the instrument. It contains seven 7-segment numeric displays, 3 discrete lamps and a b.c.d. to 7-segment decoder. The board can be removed by lightly pushing the top edge away from the front panel, until the retaining bushes come clear of the panel support, and then lifting the board from the edge connector.

4.7 ACCESS TO AMPLIFIER BUFFER

The high impedance input buffer is contained under a metal screen near the input socket. Should it be necessary to remove this screen the procedure is as follows :-

(1) Turn off the instrument.

(2) Remove the display board.

(3) Remove the retaining screw at the top-front end of the input bracket.

(4) Turn the instrument upside down and remove the two screws on the bottom of the input bracket and screen.

(5) Replace display board and switch on the instrument.

4.8 POWER SUPPLY LINKS

Inductors L1 and L2 between tags U, V and W, X below the mains switch, and the wire link between tags S and T can be removed to isolate the power supply from the counter circuit. Adjustment of the preset variable resistor R102 which sets 5.1 V should be carried out with these links in position, i.e., with a load on the power supply.

4.9 POWER SUPPLY ADJUSTMENT

If repairs have been made to the power supply, the 5.1 V line should be reset as follows:-

(1) Connect a digital voltmeter, such as the Fluke 8000A set to d.c. volts, 10 mV resolution, to link S-T.

(2) Adjust R102 until the d.v.m. reads 5.11 V ±0.1 V.

4.10 AMPLIFIER ADJUSTMENT

The following procedure should be undertaken only if repairs have been carried out to the amplifier section.

(1) Select READOUT UNITS ; MHz.

(2) Adjust R18 for a readout of .00001. Then reverse the rotation of R18 until the readout changes to .00000.

Chapter 6

Replaceable parts

Introduction

Each sub-assembly or printed circuit board in this instrument has been allocated a unit identification in the sequence A0 to A2.

The complete component reference carries its unit number as a prefix e.g. A1C1 but for convenience in the text and on circuit diagrams the prefix is not used.

However, when ordering replacements or in correspondence the complete component reference must be quoted.

The components are listed in alphanumerical order of the complete circuit reference and the following abbreviations are used :

C	:	capacitor
Carb	:	carbon
Cer	:	ceramic
Cerm	:	cermet
D	:	semiconductor diode
Elec	:	electrolytic
FS	:	fuse
IC	:	integrated circuit (package)
L	:	inductor
Max	:	maximum
ME	:	meter
Met	:	metal
Mic	:	mica
Min	:	minimum value
Ox	:	oxide
PL	:	plug
Plas	:	plastic dielectric
R	:	resistor
REG	:	regulator
S	:	switch
SK	:	socket
T	:	transformer
Tant	:	tantalum
TP	:	terminal
TR	:	transistor
Var	:	variable
WW	:	wirewound
XL	:	crystal
†	:	value selected during test; nominal value listed
Ø	:	feed-through component
W	:	watts at 70°C
⚠	:	static sensitive component

NOTE : One or more of the components fitted in this instrument may differ from those listed in this chapter for any of the following reasons :

(a) Components indicated by a † have their value selected during test to achieve particular performance limits.

(b) Owing to supply difficulties, components of different value or type may be substituted provided the overall performance of the instrument is maintained.

(c) As part of a policy of continuous development, components may be changed in value or type to obtain detail improvements in performance.

When there is a difference between the component fitted and the one listed, always use as a replacement the same type and value as found in the instrument.

Ordering

When ordering replacements, address the order to our Service Division (address on rear cover) or nearest agent and specify the following for each component required.

(1) Type* and serial number of instrument

(2) Complete circuit reference

(3) Description

(4) MI code number

*As given on the serial number label at the rear of the instrument; if this is superseded by a model number label, quote the model number instead of the type number.

Circuit reference	Description	M.I. code
Unit A0 : Overall assembly		
FS1	250mA	23411-055P
	Fuse holder	23416-191C
	Cover for fuse holder	37575-121B
IC14	MA 150S ⚠	28469-367H
L1	10μH	23642-555G
L2	10μH	23642-555G
PL1	Mains plug filter assembly	23423-150L
	Cover for mains plug/filter	37590-150P
REG1	Voltage regulator 7805	28461-707G
SA	SUPPLY ON/OFF, d.p.d.t.	23462-353A
	Cover for SA	37590-177D
	Extension spindle for SA	37590-143S
SB	230V/110 V, d.p.c.o.	23467-155G
	Cover (red) for SB	37573-145C
	Locking plate for SB	34444-116Y
T1	Mains transformer	43490-035R
	* Rubber cushion pad for T1	37490-263X

*Replace pad when replacing T1

Circuit reference	Description	M.I. code
Unit A1 : Function board		
	Complete board	44827-501Y
C1	Plas 0.1μF 10% 100V	26582-799N
C2	Cer 15pF 2.5% 750V	26324-712S
C3	Elec 100μF -20+100% 16V	26423-242X
C4	Cer 0.047μF -20+80% 25V	26383-017U
C5	Elec 100μF -20+100% 16V	26423-242X
C6	Cer 0.01μF -20+80% 100V	26383-055L
C7	Elec 470μF -20+100% 16V	26423-262J
C8	Cer 0.047μF -20+80% 25V	26383-017U
C9	Tant 47μF 20% 6V	26486-593D
C10	Cer 0.047μF -20+80% 25V	26383-017U
C11	Elec 47μF -20+100% 10V	26415-809E
C12	Cer 0.047μF -20+80% 25V	26383-017U
C13	Elec 47μF -20+100% 40V	26423-232G
C14	Cer 0.01μF -20+80% 100V	26383-055L
C15	Elec 10μF -20+100% 63V	26423-215K
C16	Elec 470μF -20+100% 16V	26423-262J
C17	Cer 0.001μF -20+80% 500V	26383-242P
C18	Cer 0.01μF -20+80% 100V	26383-055L
C19	Cer 220pF 2% 50V	26343-481S
C20	Cer 100pF 2% 50V	26343-477V
C21	Var Cer. 4.5pF -15pF	26847-115H
C22	Cer 22pF 5% 50V	26343-469N
C23	Tant 6.8μF 20% 6V	26486-560W
C24	Plas 0.1μF 10% 100V	26582-799N
C25	Cer 0.001μF -20+80% 500V	26383-242P
C26	Cer 0.001μF -20+80% 500V	26383-242P
C27	Cer 0.001μF -20+80% 500V	26383-242P
C28	Cer 0.001μF -20+80% 500V	26383-242P
C29	Cer 0.001μF -20+80% 500V	26383-242P
C30	Cer 0.001μF -20+80% 500V	26383-242P
C31	Cer 0.001μF -20+80% 500V	26383-242P
C32	Cer 0.047μF -20+80% 25V	26383-017U
C33	Cer 0.01μF -20+80% 100V	26383-055L
C34	Cer 0.047μF -20+80% 25V	26383-017U
C35	Cer 0.047μF -20+80% 25V	26383-017U
C36	Elec 1000μF -20+100% 16V	26415-825W
C37	Elec 1000μF -20+100% 16V	26415-825W
C38	Cer 0.047μF -20+80% 25V	26383-017U
C39	Elec 470μF -20+100% 40V	26415-823V
C40	Elec 470μF -20+100% 40V	26415-823V
C41	Elec 100μF -20+100% 25V	26415-813U
C42	Cer 0.047μF -20+80% 25V	26383-017U

For symbols and abbreviations see introduction to this chapter

Circuit reference	Description	M.I. code	Circuit reference	Description	M.I. code
C43	Cer 0.047μF -20+80% 25V	26383-017U	D10	1N4148	28336-676J
C44	Cer 0.047μF -20+80% 25V	26383-017U	D11	1N4148	28336-676J
C45	Elec 100μF -20+100% 25V	26415-813U	D12	BB142	28381-097W
C46	Cer 0.047μF -20+80% 25V	26383-017U	D13	Z5B 13.0	28372-213U
C47	Elec 470μF -20+100% 16V	26423-262J	D14	Z5B 13.0	28372-213U
C48	Elec 47μF -20+100% 40V	26423-232G	D15	1N4004	28357-028K
C49	Elec 47μF -20+100% 40V	26423-232G	D16	1N4004	28357-028K
C50	Cer 0.047μF -20+80% 25V	26383-017U	D17	1N4004	28357-028K
C51	Cer 0.047μF -20+80% 25V	26383-017U	D18	1N4004	28357-028K
C52	Cer 0.047μF -20+80% 25V	26383-017U	D19	1N4004	28357-028K
C53	Cer 0.047μF -20+80% 25V	26383-017U	D20	1N4004	28357-028K
C54	Cer 0.047μF -20+80% 25V	26383-017U	D21	1N4004	28357-028K
C55	Cer 0.047μF -20+80% 25V	26383-017U	D22	1N4004	28357-028K
C56	Cer 0.047μF -20+80% 25V	26383-017U			
C57	Cer 0.047μF -20+80% 25V	26383-017U	IC1	MC10216P	28469-169J
C58	Cer 0.047μF -20+80% 25V	26383-017U	IC2	MC10105P	28466-105Z
C59	Cer 0.047μF -20+80% 25V	26383-017U	IC3	MC10131P	28462-605R
C60	Cer 0.047μF -20+80% 25V	26383-017U	IC4	MC10131P	28462-605R
C61	Cer 0.047μF -20+80% 25V	26383-017U	IC5	7490	28464-002E
C62	Cer 0.047μF -20+80% 25V	26383-017U	IC6	7472	28462-003L
C63	Cer 0.047μF -20+80% 25V	26383-017U	IC7	7474	28462-002N
C64	Cer 0.047μF -20+80% 25V	26383-017U	IC8	74123	28468-302D
C65	Cer 0.047μF -20+80% 25V	26383-017U	IC9	74121	28468-402S
C66	Cer 0.047μF -20+80% 25V	26383-017U	IC10	74132	28469-202E
C67	Cer 0.047μF -20+80% 25V	26383-017U	IC11	7490	28464-002E
			IC12	7403	28466-322J
D1	1N4148	28336-676J	IC13	74145	28465-018E
D2	Z5B 3.0	28371-203G	IC14	MA150S ⚠	28469-367H
D3	1N4148	28336-676J	IC15	7404	28469-156B
D4	Z5B 3.0	28371-203G			
D5	MBD 102	28349-004A	R1	Met film 1kΩ 2% ¼W	24773-273A
D6	1N4148	28336-676J	R2	Carb. 1MΩ 5% 1/8W	24311-945Y
D7	1N4148	28336-676J	R3	Met film 10Ω 2% ¼W	24773-225W
D8	1N4148	28336-676J	R4	Carb. 10MΩ 10% 1/8W	24321-885W
D9	BAY72	28337-126P	R5	Met film 4.7kΩ 2% ¼W	24773-289W

For symbols and abbreviations see introduction to this chapter

Circuit reference	Description	M.I. code	Circuit reference	Description	M.I. code
R6	Met film 10Ω 2% ¼W	24773-225W	R41	Met film 510Ω 2% ¼W	24773-266C
R7	Met film 4.7kΩ 2% ¼W	24773-289W	R42	Met film 680Ω 2% ¼W	24773-269K
R8	Met film 10Ω 2% ¼W	24773-225W	R43	Met film 510Ω 2% ¼W	24773-266C
R9	Met film 22kΩ 2% ¼W	24773-305R	R44	Met film 510Ω 2% ¼W	24773-266C
R10	Met film 220kΩ 2% ¼W	24773-329T	R45	Met film 2.2kΩ 2% ¼W	24773-281Y
R11	Met film 47Ω 2% ¼W	24773-241A	R46	Met film 510Ω 2% ¼W	24773-266C
R12	Met film 750Ω 2% ¼W	24773-270R	R47	Met film 2.2kΩ 2% ¼W	24773-281Y
R13	Met film 10Ω 2% ¼W	24773-225W	R48	Met film 510Ω 2% ¼W	24773-266C
R14	Met film 27Ω 2% ¼W	24773-235R	R49	Met film 2.2kΩ 2% ¼W	24773-281Y
R15	Met film 2.2kΩ 2% ¼W	24773-281Y	R50	Met film 510Ω 2% ¼W	24773-266C
R16	Met film 10kΩ 2% ¼W	24773-297M	R51	Met film 510Ω 2% ¼W	24773-266C
R17	Met film 1kΩ 2% ¼W	24773-273A	R52	Met film 2.2kΩ 2% ¼W	24773-281Y
R18	Var cermet 10kΩ 10% ½W	25711-543D	R53	Met film 2.2kΩ 2% ¼W	24773-281Y
R19	Met film 100Ω 2% ¼W	24773-249J	R54	Met film 510Ω 2% ¼W	24773-266C
R20	Met film 1kΩ 2% ¼W	24773-273A	R55	Met film 2.2kΩ 2% ¼W	24773-281Y
R21	Met film 3.9kΩ 2% ¼W	24773-287V	R56	Met film 510Ω 2% ¼W	24773-266C
R22	Met film 330Ω 2% ¼W	24773-261D	R57	Met film 150Ω 2% ¼W	24773-253F
R23	Met film 15kΩ 2% ¼W	24773-301P	R58	Met film 510Ω 2% ¼W	24773-266C
R24	Met film 510Ω 2% ¼W	24773-266C	R59	Met film 330Ω 2% ¼W	24773-261D
R25	Met film 680Ω 2% ¼W	24773-269K	R60	Met film 510Ω 2% ¼W	24773-266C
R26	Met film 510Ω 2% ¼W	24773-266C	R61	Met film 680Ω 2% ¼W	24773-269K
R27	Met film 510Ω 2% ¼W	24773-266C	R62	Met film 68kΩ 2% ¼W	24773-317N
R28	Met film 510Ω 2% ¼W	24773-266C	R63	Met film 2.2kΩ 2% ¼W	24773-281Y
R29	Met film 10Ω 2% ¼W	24773-225W	R64	Met film 2.2kΩ 2% ¼W	24773-281Y
R30	Met film 510Ω 2% ¼W	24773-266C	R65	Met film 510Ω 2% ¼W	24773-266C
R31	Met film 510Ω 2% ¼W	24773-266C	R66	Met film 1.5kΩ 2% ¼W	24773-277U
R32	Met film 330Ω 2% ¼W	24773-261D	R67	Met film 1kΩ 2% ¼W	24773-273A
R33	Met film 22kΩ 2% ¼W	24773-305R	R68	Met film 47kΩ 2% ¼W	24773-313H
R34	Met film 510Ω 2% ¼W	24773-266C	R69	Met film 47kΩ 2% ¼W	24773-313H
R35	Met film 510Ω 2% ¼W	24773-266C	R70	Met film 4.7kΩ 2% ¼W	24773-289W
R36	Met film 10Ω 2% ¼W	24773-225W	R71	Met film 100kΩ 2% ¼W	24773-321L
R37	Met film 22kΩ 2% ¼W	24773-305R	R72	Var cermet 10kΩ 10% 0.3W	25748-507X
R38	Met film 330Ω 2% ¼W	24773-261D	R73	Met film 3.3kΩ 2% ¼W	24773-285F
R39	Met film 200Ω 2% ¼W	24773-256S	R74	Met film 47Ω 2% ¼W	24773-241A
R40	Met film 22kΩ 2% ¼W	24773-305R	R75	Met film 1kΩ 2% ¼W	24773-273A

For symbols and abbreviations see introduction to this chapter

Circuit reference	Description	M.I. code
R76	Met film 3.3kΩ 2% ¼W	24773-285F
R77	Met film 3.3kΩ 2% ¼W	24773-285F
R78	Met film 3.3kΩ 2% ¼W	24773-285F
R79	Met film 3.3kΩ 2% ¼W	24773-285F
R80	Met film 3.3kΩ 2% ¼W	24773-285F
R81	Met film 3.3kΩ 2% ¼W	24773-285F
R82	Met film 3.3kΩ 2% ¼W	24773-285F
R83	Met film 330Ω 2% ¼W	24773-261D
R84	Met film 330Ω 2% ¼W	24773-261D
R85	Met film 330Ω 2% ¼W	24773-261D
R86	Met film 330Ω 2% ¼W	24773-261D
R87	Met film 330Ω 2% ¼W	24773-261D
R88	Met film 330Ω 2% ¼W	24773-261D
R89	Met film 330Ω 2% ¼W	24773-261D
R90	Met film 3.3kΩ 2% ¼W	24773-285F
R91	Met film 330Ω 2% ¼W	24773-261D
R92	Met film 4.7kΩ 2% ¼W	24773-289W
R93	Met film 3.3kΩ 2% ¼W	24773-285F
R94	Met film 330Ω 2% ¼W	24773-261D
R95	Met film 4.7kΩ 2% ¼W	24773-289W
R96	Met film 3.3kΩ 2% ¼W	24773-285F
R97	Met film 330Ω 2% ¼W	24773-261D
R98	Met film 330Ω 2% ¼W	24773-261D
R99	Met film 3.3kΩ 2% ¼W	24773-285F
R100	Met film 1kΩ 2% ¼W	24773-273A
R101	Met film 10kΩ 2% ¼W	24773-297M
R102	Var cermet 100Ω 10% ½W	25711-545P
R103	WW 100Ω 5% 1½W	25123-050L
R104	WW 100Ω 5% 1½W	25123-050L
R105	Met film 4.7kΩ 2% ¼W	24773-289W
R106	Met film 3.3kΩ 2% ¼W	24773-285F
SA, SB, SC, SD	Push button switch assembly 44338-053Y	
SE	INT/EXT, d.p.c.o.	23467-155G
SKA	INPUT, 50Ω BNC receptacle	23443-406R
SKB	EXT IN, 50Ω BNC receptacle	23443-446H
SKC	INT OUT, 50Ω BNC receptable	23443-446H
SKD	Edge connector, 20-way	23435-056W
TR1	40673 ⚠	28459-010V
TR2	BSX20	28452-197H
TR3	2N5179	28451-697Y
TR4	2N5179	28451-697Y
TR5	BC308B	28433-455R
TR6	BC308B	28433-455R
TR7	BC308B	28433-455R
TR8	BC308B	28433-455R
TR9	MPSL08	28431-767E
TR10	BC238B	28452-781A
TR11	BC238B	28452-781A
TR12	BC238B	28452-781A
TR13	2N5448	28433-838Z
TR14	2N5448	28433-838Z
TR15	2N5448	28433-838Z
TR16	2N5448	28433-838Z
TR17	2N5448	28433-838Z
TR18	2N5448	28433-838Z
TR19	2N5448	28433-838Z
TR20	BC238B	28452-781A
TR21	BC238B	28452-781A
TR22	BC238B	28452-781A
TR23	BC238B	28452-781A
TR24	MM4001	28438-436V
TR25	MM3001	28458-406T
	Heat sink for TR24 and TR25 (1 of 2)	28488-448H
XL1	10 MHz, AT cut	28312-047U

For symbols and abbreviations see introduction to this chapter

Circuit reference	Description	M.I. code
Unit A2 : Display board		
	Complete board	44827-549M
C1	Cer 0.047μF -20+80% 25V	26383-017U
IC1	SN7447	28465-005P
LP1	LED, red, FLV140	28624-109M
LP2	LED, red, FLV140	28624-109M
LP3	LED, red, FLV140	28624-109M
LP4	LED, red, FLV140	28624-109M
R1	Met film 47Ω 2% ¼W	24773-241A
R2	Met film 47Ω 2% ¼W	24773-241A
R3	Met film 47Ω 2% ¼W	24773-241A
R4	Met film 47Ω 2% ¼W	24773-241A
R5	Met film 47Ω 2% ¼W	24773-241A
R6	Met film 47Ω 2% ¼W	24773-241A
R7	Met film 47Ω 2% ¼W	24773-241A
Miscellaneous mechanical parts		
	Wrap-round case	35901-587A
	Case base plate (less handle assembly)	35901-586K
	Aperture plate for rear panel	35901-572V
	Edging surround for case (1 of 2)	37590-117M
	Tilt handle	37587-925L
	Handle attachment	37588-110B
	Case foot (1 of 2)	22315-663B
	Earthing contact on side frame (1 of 2)	31559-005X
	Buttress moulding, red, supporting display board (1 of 2)	37590-141G
Accessories		
	Mains lead, with straight 3-way socket	43123-076Y
	Mains lead, with angled 3-way socket	43129-163L
	Coaxial lead, with BNC plugs	43126-013W
	Stowage lid for front panel, complete with clips	41690-158L
	Retaining cover for stowage lid	35901-684M
	Fixing stud for cover (1 of 2)	21186-365V
	Rubber washer for fixing stud (1 of 2)	21186-362J
	Rear stand	35901-686R
	Hand strap	22315-578S
	Shoulder strap	22315-577V

For symbols and abbreviations see introduction to this chapter

Chapter 7

Circuit diagrams

CIRCUIT NOTES

1. COMPONENT VALUES

Resistors : No suffix = ohms, k = kilohms, M = megohms.
Capacitors : No suffix = microfarads, p = picofarads.
Inductors : No suffix = henries, m = millihenries, μ = microhenries.
SIC : value selected during test; nominal value shown.

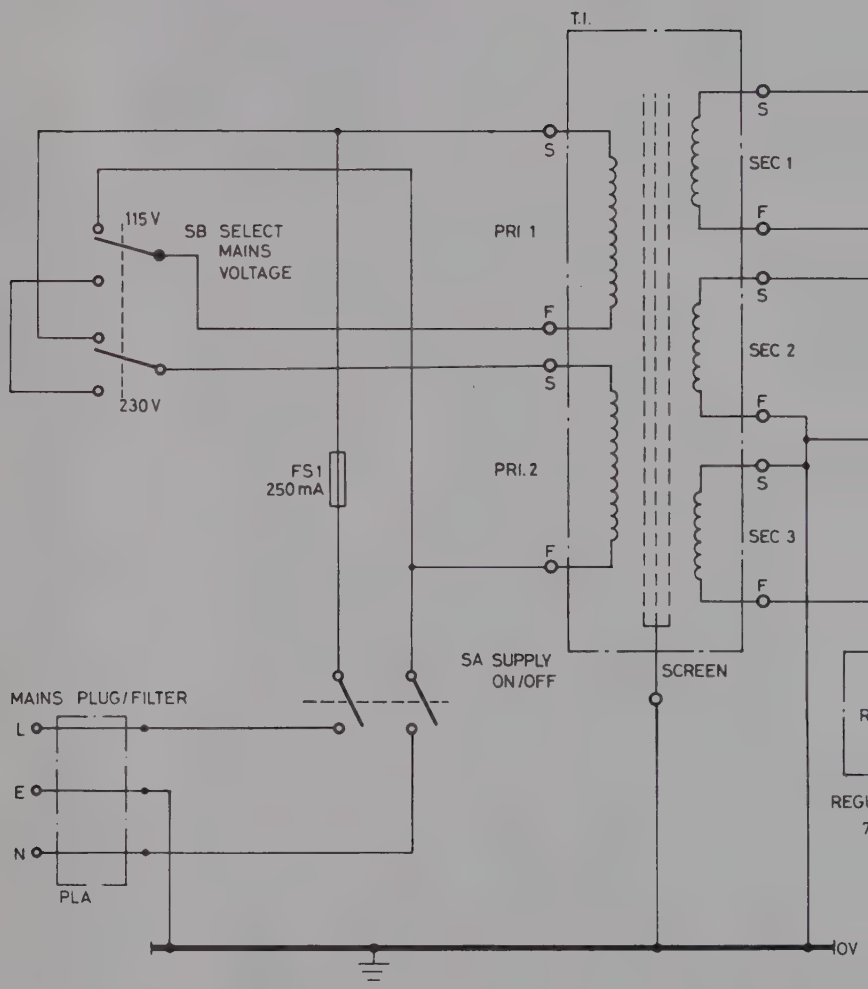
2. VOLTAGES

Voltages are d.c. and relative to chassis unless otherwise indicated. Measured with 20 kΩ/V meter.

3. SYMBOLS

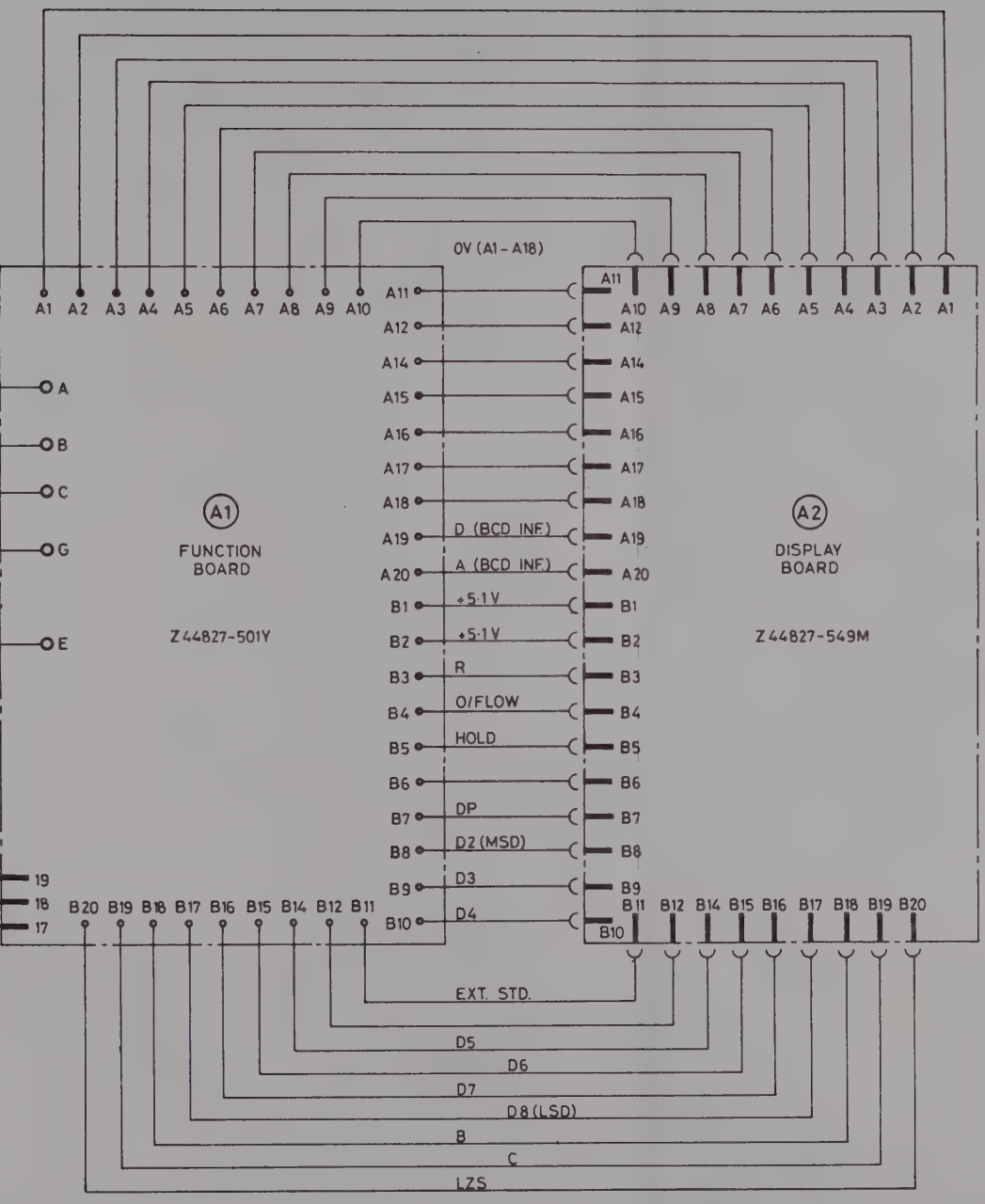
Generally in accordance with BS 3939.

⚠ see CAUTION notes in Sects. 2.2 and 4.1.



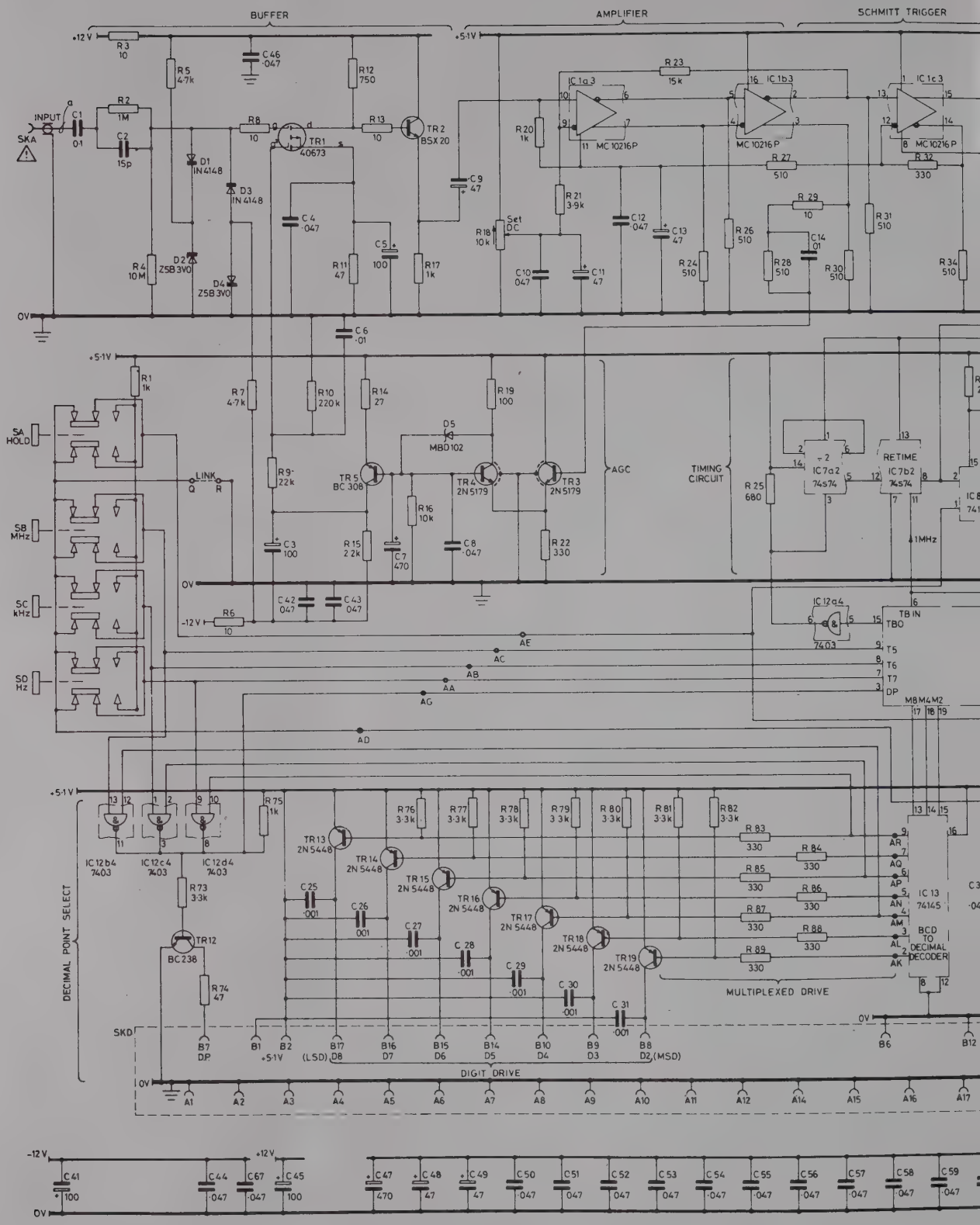
SZ52430-900Y Iss.1

INTE



ECTION DIAGRAM : A0

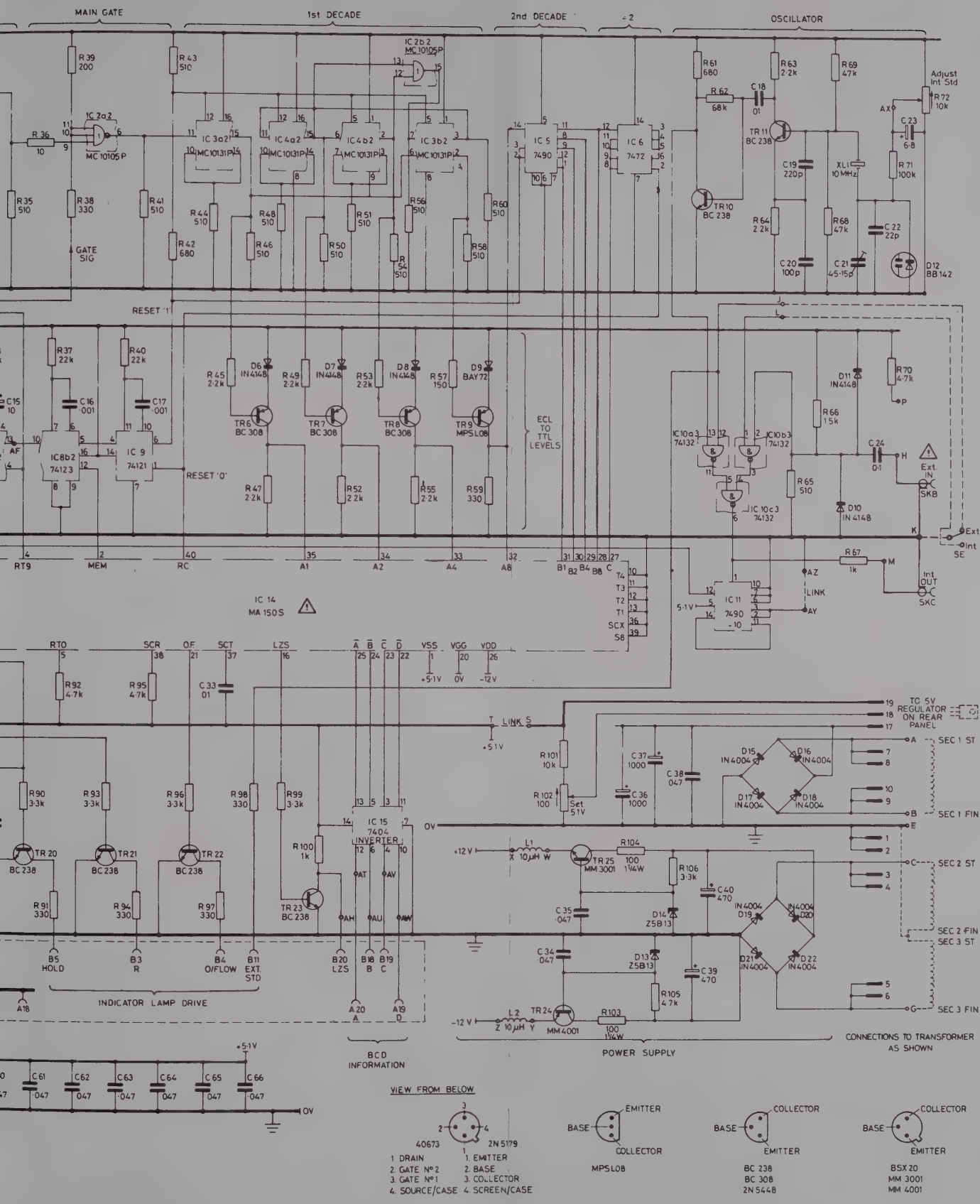
Fig. 7.1



Z 44827 - 501 Y Iss.1

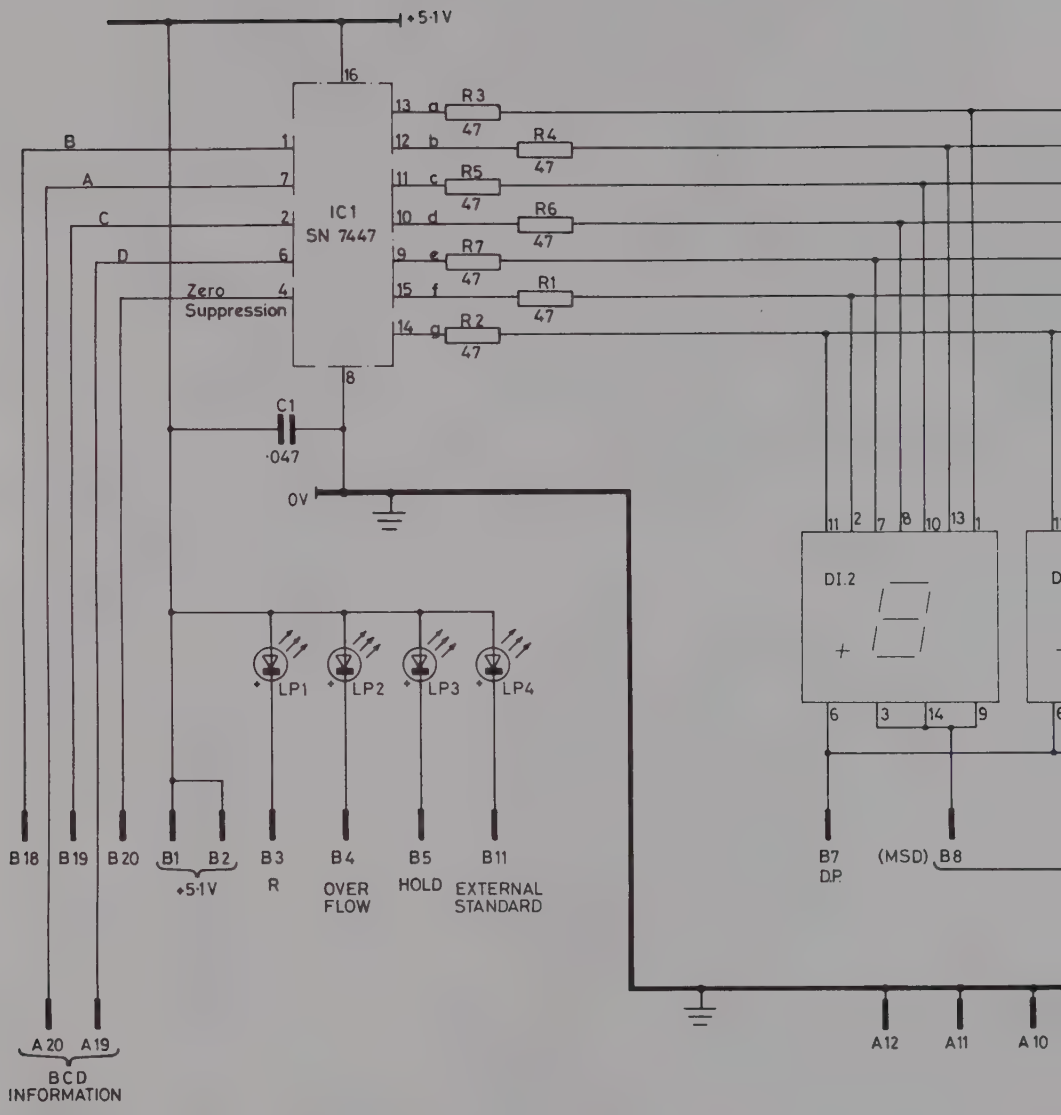
FUN

2430-900 (1)

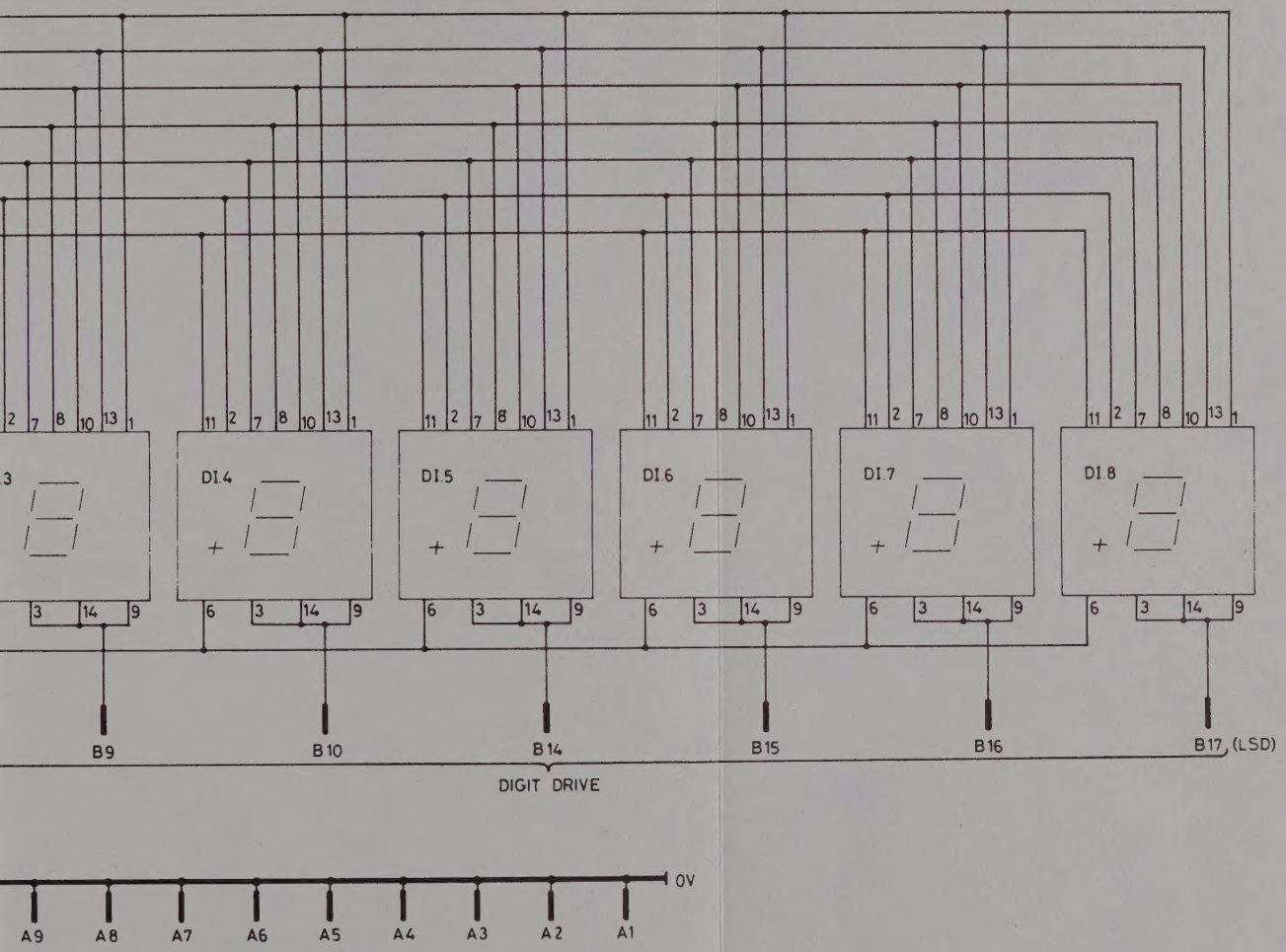


TION BOARD : A1

Fig.7.2

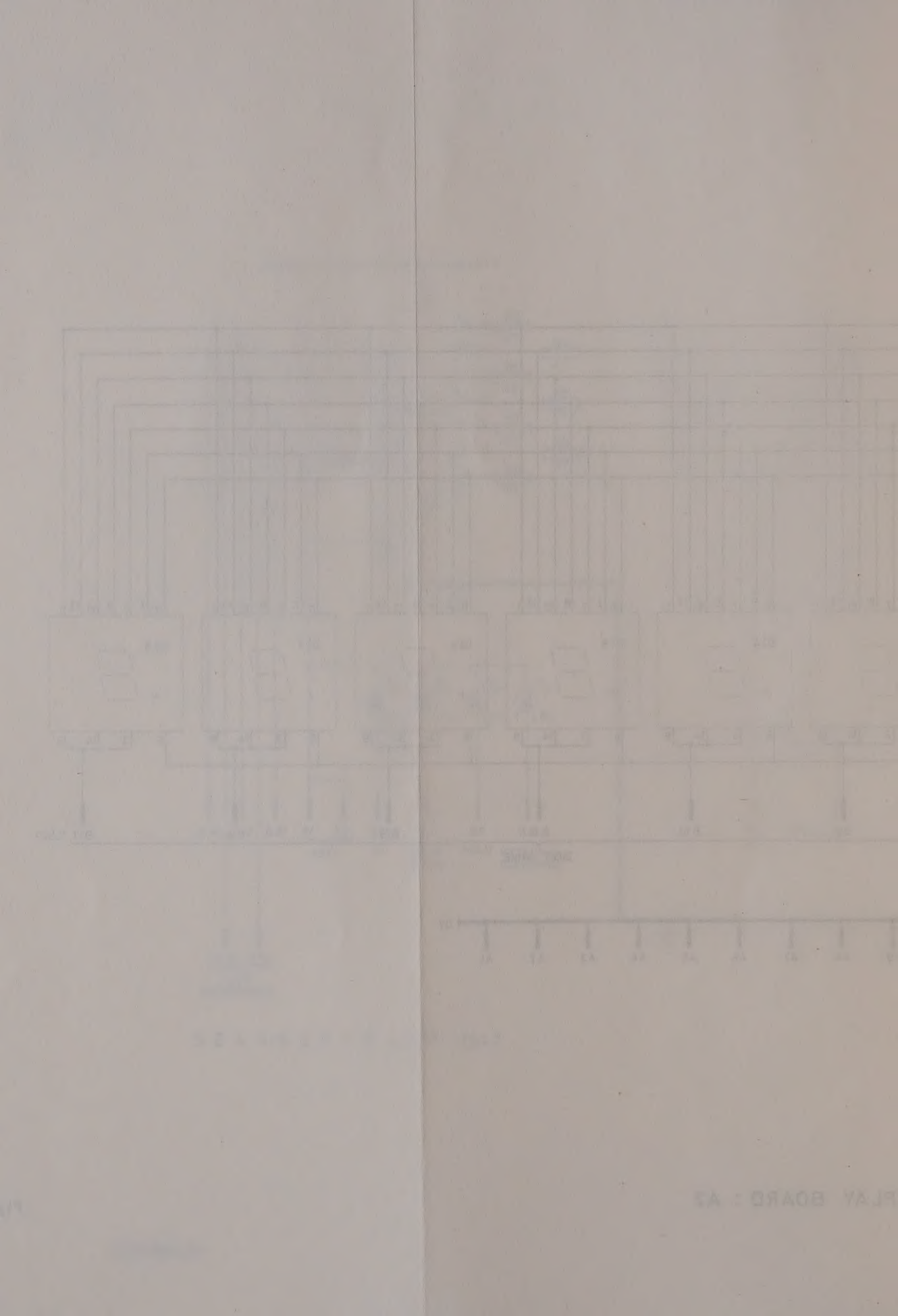


SZ44827-549M Iss.1



DISPLAY BOARD : A2

Fig.7.3



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